Zero Retries issue 0168 2024-09-04

Zero Retries is an independent newsletter promoting technological innovation that is occurring in Amateur Radio, and Amateur Radio as (literally) a license to experiment with and learn about radio technology. Radios are computers - with antennas! Now in its fourth year of publication, with 2000+ subscribers.

About Zero Retries

Steve Stroh N8GNJ, Editor

Jack Stroh, Late Night Assistant Editor Emeritus

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Web version of this issue - https://www.zeroretries.org/p/zero-retries-0168

Request To Send

Commentary by Editor Steve Stroh N8GNJ

Paid Subscribers Update

My thanks to **Prefers to Randy Smith WU2S** for *renewing* as a **Founding Member Annual Subscriber** to Zero Retries this past week!

Founding members are listed in every issue of Zero Retries!

My thanks to my old friend and former colleague **Sid Siegel** for *renewing* as an **Annual Paid Subscriber** to Zero Retries this past week!

My thanks to **Bill Sefton N6OWF** for *upgrading* from a free subscriber to an **Annual Paid Subscriber** to Zero Retries this past week!

My thanks to **Jeff Hochberg W4JEW** for *upgrading* from a free subscriber to an **Annual Paid Subscriber** to Zero Retries this past week!

Financial support from Zero Retries readers is a significant vote of support for the continued publication of Zero Retries.

Nice Things Said About Zero Retries Department

In a private email correspondence this past week, a Zero Retries adviser said:

> You and ZR are really the voice for the real advancement in Amateur Radio.

Wow. That was *powerful*, and appreciated.

I don't… *had not previously*… thought of Zero Retries in quite such absolute terms, but that statement was made by someone else (with standing, in my opinion, to make such an observation) and their statement was unsolicited.

Thus, I'll accept that statement with grace and Thanks. And try to continue to live up to it.

I'll mention once again that Zero Retries, was created, and over the previous three years, *shaped*, out of frustration that other Amateur Radio "media" *should* be doing this job - with their greater resources, reporting out into their much wider audiences in Amateur Radio[1] about the amazing diversity and quantity of technological innovation occurring in the present within Amateur Radio. Eventually I got irritated enough about this lack that I decided "If *they're* not going to do it… I can't do any worse by trying to do it myself." And thus, Zero Retries was born, and continues.

I wish it didn't feel necessary for what I write about in Zero Retries to be pushing out quite so far onto the bleeding edges of technological innovation in Amateur Radio. In previous decades, I would happily read articles by others about technological innovation by others far smarter, more accomplished, and more involved than I am. One prime example is the May 1995 issue of QST. But in *this* era, other than the occasional Zero Retries Interesting YouTube video, or some tightly focused (silo'd) organizations (the satellite orgs, the low power techies, the Amateur Radio television folks, the software radio crowd, etc.), no other person or organization seems to

be attempting to cover the *totality* of the technological innovation that's *happening* in Amateur Radio *in this era*!

So, thank you, unnamed advisor, and all the advisors, friends, and contributors (and especially the Zero Retries Pseudostaffers) who "keep me in the loop" behind the scenes, about the *interesting* stuff going on in Amateur Radio. And Thank You once again to the Founding Members and the Paid Subscribers who financially support the expenses incurred in publishing Zero Retries, and enabling several future fun projects that will emerge this Fall now that Zero Retries is paying its own way.

Newest Zero Retries Pseudostaffers - Cale Mooth K4HCK and Tom Salzer KJ7T

Cale Muth K4HCK and **Tom Salzer KJ7T** have been named to the exalted ranks of Zero Retries Pseudostaffers.

Zero Retries Pseudostaffers are folks that contribute regularly and substantively to me and Zero Retries by providing "heads up" notifications, feedback, and posting to their own outlets (email lists, blogs, newsletters, etc.).

K4HCK's contribution as a Zero Retries Pseudostaffer is **Amateur Radio Weekly** **(ARW)**. I can't think of a weekly issue of ARW in the past year where there wasn't at *least one* Zero Retries Interesting item, and it's regularly the case that an issue of ARW consists *mostly* of Zero Retries Interesting items. Zero Retries publishes on Fridays at 15:30 Pacific, and ARW publishes sometime in the wee hours of Saturday mornings. Thus I look forward to ARW to see "what did K4HCK spot that I missed"?

KJ7T's contribution as a Zero Retries Pseudostaffer is his weekly newsletter **The Random Wire**. I particularly value KJ7T's writing every week as, similarly to Zero Retries, he writes longer, explanatory pieces in a conversational style. KJ7T delves into technical areas of Amateur Radio, usually from a hands-on perspective, that I just don't quite have the bandwidth to cover. Most issues of The Random Wire almost alway requires multiple readings to grasp all of the content2. When KJ7T publishes an article that's overwhelmingly Zero Retries Interesting, I often just mention it in passing in Zero Retries' **ZR > BEACON** section because I usually can't offer any better context on a subject than KJ7T's writing.

Thank you ***Cale*** and ***Tom*** for your invaluable assistance with Zero Retries over the past several years, and I continue to expect great things of you as Zero Retries Pseudostaffers! 🤣

In This Connected Era…

I wrote this item as a footnote in the FCC Comments as a minor illustration of how hyper-connected we have become (and how much we "value" such hyper-connectivity). But rereading it during an editing pass, it was a bit too "familiar" and off-topic for the FCC, so I moved it here.

In *my* household, the oddest examples of continuous connectivity that I never would have

imagined as recently as five years ago, are:

1. Our new firmness and adjustable headboard *bed* wants to be connected to the Internet so it can report back to me on the "quality of my sleep" (declined).

2. My Positive Airway Pressure (PAP) appliance has a built-in cellular modem and thus offers to advise me, via an app, on the "quality of my sleep" (declined).

3. My continuous glucose monitor adhered to my arm connects via Bluetooth to my mobile phone to let my doctor see a chart of my varying glucose levels, which I allow.

4. Though my watch is a "smart watch" with both Bluetooth and Wi-Fi connectivity, it's now "old fashioned" that it doesn't have its *own cellular modem,* which is nearly standard on current models of my watch. But my next smart watch *will* have one.

We live in such a wondrous era of technology… especially *radio* technology, of which I am continuously, endlessly *fascinated*.

Apologies for Not Publishing This Issue As Early as Promised

In Zero Retries 0167 I said that I hoped to publish this issue of Zero Retries on Tuesday 2024-09-03. Unfortunately, I underestimated the time that my contributions to two (non Zero Retries) writing projects would require. My contributions to both of those writing projects were "behind the scenes", and time sensitive because additional work on them by others was pending on my inputs. Thus this week-long stretch of intense writing was a bit grueling. I consider both of those projects to be important to the future of Amateur Radio so that was time well-spent, but it impacted the delivery of this issue of Zero Retries.

Thus apologies for Zero Retries Readers seeing this issue barely 24 hours before Comments on FCC Docket 24-240 are due.

***Reply* Comments** on FCC Docket 24-240 are due on **2024-09-20**, and I will be working on the Reply Comments issue of Zero Retries nearly immediately… after taking a one or two day break from this solid week of writing, and getting my Docket 24-240 comments formally submitted to the FCC.

***And*… Apologies to Non-US Readers for This US-Centric Issue**

This issue is dedicated to FCC Docket 24-240 regarding the US 902-928 MHz band. While that band is also available in a few other countries such as Canada, only the US is impacted by the FCC considering the reconfiguration of 902-928 MHz. I consider 902-928 MHz to very important to the future of US Amateur Radio, and to radio technology experimentation in general, thus, this dedicated issue of Zero Retries seems justified.

Have a great weekend, all of you co-conspirators in Zero Retries Intersting Amateur Radio

activities!

Steve N8GNJ

Leave a comment

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Backgrounder on Commenting on FCC Docket 24-240

By Steve Stroh N8GNJ

My backgrounder to Zero Retries readers, and my comments to the FCC regarding FCC Docket 24-240, NextNav's attempted reconfiguration (hostile takeover) of the 902-928 MHz band in the US, due by end of day 2024-09-05.

Please understand that what follows is my personal perspective on how best to offer comments

to the FCC on Docket 24-240. I'd like to think my comments are "informed", but in the end they are my comments from my background and my perspective.

If you offer your comments to the FCC based on what you read here, please don't accept what I say "blindly". If you read my points, and agree, great. But please don't consider me and my comments an all authoritative source.

Primary things to know about FCC Docket 24-240

- FCC WTB and OET Seek Comment on NextNav Petition for Rulemaking (PDF)
- ARRL Guide to Filing Comments with FCC (how to use the FCC's Electronic Comment Filing System (ECFS).
- The FCC ECFS allows either "fill or paste comments into a text box" or attachment of a document file. If you intend to attach a document file, please consider the following from someone who spent several days reading Comments submitted to Docket 24-240. I recommend:
    - Convert your document file to a PDF, and submit the PDF file. While the ECFS does allow the file format to be a .txt, a .rtf, a .doc, or a .docx, those types of files cause a "helper app" to be loaded, and (at least, in my opinion), *that's a pain*. Microsoft Word as a "reader" was such a pain I disabled it on my system. In contrast, a PDF file opens right in the web browser and is formatted exactly as the author laid it out.
    - From experience, when I use web addresses in a filing to the FCC, I don't attempt to do hyperlinks. Instead I follow the word(s) that would be hyperlinked with the URL in parentheses such as (https://hyper.link). I've seen FCC submissions where the hyperlinks were converted and mangled to the point where the hyperlinks were rendered unusable.
    - I know that legal documents use footnotes (and the FCC uses them extravagantly). But like hyperlinks, I've seen submissions to the FCC where the footnotes were mangled (often cut off) and thus rendered unusable. Thus I don't incorporate footnotes in my FCC submissions. (Yes, this issue of Zero Retries includes footnotes, but when I convert my comments for submission, there won't be any footnotes.)
    - Include your name and the docket number in the filename, such as: FCC_24-240_Comments_of_Steven_K_Stroh. With that, the bare minimum of information about your input is discernible when downloaded into a directory of other such files.
    - This next is a very personal preference from dealing with files accessed from mixed operating systems such as UNIX and Linux and MS-DOS3 that "barf" on filenames with spaces and characters other than dashes (-) and underscores (_). I generally create filenames as a string, using only dashes and underscores as separators. For my personal use, I only use lowercase characters, but that's often

annoying to those less geeky than I, so for "polite company" like this, I use mixed case in a filename.

- The close of the Comment period is end of day Thursday 2024-09-05 - ***tomorrow***! If it's not possible to submit your comments by then, submit them anyway, as soon as possible (it cannot hurt). The FCC will eventually close Comment submission.
- Following the Comment period, there is a Reply to Comment period which ends 2024-09-20.
- Here is the listing (search) of Comments on Docket 24-240 filed to date (more than 400)
- Previously coverage of FCC Docket 24-240 in Zero Retries:
    - **Zero Retries 0165** - ARRL and Meshtastic Publicize the Fight to Save 902-928 MHz
    - **Zero Retries 0167** - FCC Docket 24-240 Deadline for Comments is Thursday 2024-09-05

In my (very incomplete) reading of comments, the three main types of responders are industry / government users such as Radio Frequency Identification (RFID) and Internet of Things (IOT), Meshtastic users, and Amateur Radio Operators.

What the FCC Wants to Hear About (Cares About)

A trusted advisor provided me with this short, pithy, realistic, and a bit brutal "reality check" list of the real priorities of the FCC in considering issues such as Docket 24-240:

- Innovation
- Creating new tax paying businesses
- Unserved and underserved populations
    - Native Americans
    - People with disabilities
    - Schoolchildren
- Emergency communications
- Broadband communications
- Revenue to the US government (spectrum auctions)
- Cellular Telecommunications & Internet Association (CTIA)[4]
- National Association of Broadcasters (NAB)[5]

This adviser consistently offers “distilled wisdom” on matters relating to the FCC, and I am very grateful for his input such as this.

To this adviser’s points, I would add:

- Addressing the shortage of the Spectrum Workforce as outlined in the Biden-Harris Administration’s National Spectrum Strategy (https://www.ntia.gov/issues/national-spectrum-strategy) to expand the workforce of of those knowledgeable about radio technology to create new radio technology systems and build and maintain radio technology systems.

- STEM education (we need more techies, not just programmers)

- US national and regional security, including (radio systems) cybersecurity

- US national economic activity / impact (not necessarily just paying taxes)

Note that “hobbyist” activity such as “playing around with Meshtastic” or “chatting on an Amateur Radio repeater” does not appear on the above list. Such activities are simply not on the FCC’s “cares about” list. But using Meshtastic to encourage STEM and Maker activities by students and youth, or Amateur Radio repeaters to provide emergency and “no dependence on cellular, Internet, or satellite” communications is something that the FCC “cares about”.

Attacking NextNav Won’t Make an Impact With the FCC

Expressing one’s opinions about NextNav’s business model, technology, motivations, or its assertions about its importance to the overall security of the US as “backup” for GPS will not make an impact with the FCC, in my opinion. For example, claiming that that NextNav’s actions “aren’t fair” will have no impact with the FCC.

It’s settled precedent that NextNav obtained a license for its services from the FCC to operate in 902-928 MHz. What’s at issue is NextNav’s claims that its proposed reconfiguration of 902-928 MHz into dedicated sub-bands for its operations “minimally impacts” other uses of 902-928 MHz, and that the current rules on “interference” should be altered to favor NextNav’s (proposed) operations.

However specious and self-serving NextNav’s claims seem (their “create more 5G spectrum” is particularly galling to me), offering comments that are essentially “emotional” attacks on NextNav’s claims simply won’t make any impact with the FCC.

In short, for maximum impact with the FCC, comments against NextNav’s proposed changes to 902-928 MHz need to be made on standing, facts, merit, technical aspects, and especially the “FCC cares about…” points.

“Standing” is that as an Amateur Radio Operator, I am qualified to comment on how NextNav’s proposed changes will impact Amateur Radio Operations on 902-928 MHz. But I also have standing, as a citizen user of 902-928 MHz, to comment. Admittedly it’s a bit tricky to offer “citizen” comments that aren’t “hobbyist”, but I think it’s possible.

Mostly it's important to remember that Amateur Radio operations in 902-928 MHz are secondary to NextNav's operations in 902-928 MHz. Not only are Amateur Radio operations in 902-928 MHz secondary to NextNav, they are tertiary to other operations such as industrial use, US military RADAR, as well as Location and Monitoring Services (LMS) which is the type of service that NextNav offers in 902-928 MHz. Amateur Radio is not the "big dog" in 902-928 MHz.

Leave a comment

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Comments of Steven K. Stroh Regarding FCC Docket 24-240

Submitted 2024-09-05 via the FCC Electronic Comments Filing System as a PDF file, filename FCC_24-240_Comments_Steven_K_Stroh_2024-09-05.

Abstract

I feel that the radical reconfiguration of 902-928 MHz proposed by NextNav in Docket 24-240 is not in the broadest possible public interest. 902-928 MHz is a unique portion of spectrum, with an enormous number of users and systems, using widely varying technologies and techniques to to coexist and cooperate in 902-928 MHz. In short 902-928 MHz is a unique ecosystem for radio technology in the US, and its current configuration should be continued. I will cite a number of technologies which provide equivalent services and capabilities to those that NextNav states can only be provided by its proprietary technology and by radical reconfiguration and disruption of 902-928 MHz.

Background

I am an Amateur Radio Operator (callsign N8GNJ), licensed for nearly 40 years. I am a GMRS user (callsign WRPS598). I also had a Citizens Band license - callsign xxxxxxx. My professional background is an Electronic Technician, computing System Administrator, and Technology Writer. I live in Bellingham, Washington. I write a weekly independent newsletter called Zero Retries (www.zeroretries.org) that highlights technological innovation occurring in Amateur Radio worldwide.

My primary interest within Amateur Radio is operating data communications modes, experimentation, and helping to develop and prove new radio-based data communications modes. In Zero Retries every week, I document the remarkable evolution in radio technology occurring in Amateur Radio based on new technologies such as Software Defined Radio (software and hardware), Digital Signal Processing, novel and new antenna techniques, use of multiple inexpensive receivers and many other fascinating new approaches and technologies applied to old problems in radio communications.

In short, I posit to the readers of Zero Retries that Amateur Radio is a literal license to experiment with radio technology, with low barriers to entry, especially in the Amateur Radio VHF / UHF bands of which 902-928 MHz is one.

While my primary standing to comment on Docket 24-240 is my perspective as an Amateur Radio Operator, I also feel qualified to comment on Docket 24-240 as a member of the general public (a citizen) who uses 902-928 MHz for experimental and education purposes, as well as mundane uses of 902-928 MHz such as a cordless telephone that was specifically chosen for its operation on 902-928 MHz to not be interfered by my wireless systems operating on 2.4 GHz.

Comments on Amateur Radio Usage of 902-928 MHz

Amateur Radio operations readily acknowledge their place in the hierarchy of operations within 902-928 MHz and has figured out how to "fit in", typically by placing its systems and operations at the lower and upper ends of of the band where the "noise" from unlicensed systems is lowest.

In some parts of the US, use of portions, or all, of the (shared) "Amateur Radio" 420-450 MHz band is prohibited due to the primary user of this band - operation of the US military's PAVE PAWS RADAR systems.

Another band where Amateur Radio operations seem likely to be severely restricted is the 1240-1300 MHz band where the primary user is Global Navigation Satellite Systems (GNSS) which have begun coming online in the past several years, primarily Europe's Galileo system.

Thus, many US Amateur Radio operators, clubs, and systems such as repeaters, have begun using 902-928 MHz - quite successfully (and uneventfully to other uses and users of 902-928 MHz).

Many Amateur Radio commenters have described the technical issues of radio systems used for Amateur Radio in 902-928 MHz as to why it is infeasible to reconfigure them to accommodate NextNav's suggested reconfiguration of the band.

Thus, in many areas where 420-450 MHz is unavailable for Amateur Radio use, Amateur Radio's ability to provide emergency communications, with no dependence on communications infrastructure such as cellular networks, Internet, or satellite, would be reduced or curtailed if NextNav's suggested reconfiguration of 902-928 MHz were implemented.

If NextNav's suggested reconfiguration of the band is implemented, Amateur Radio's ability to provide emergency communications using 902-928 MHz would be severely reduced or curtailed. Thus, that impact on emergency communications capability should be a consideration by the Commission.

If 902-928 MHz Is Reconfigured Per NextNav's Request, a Unique Spectrum Ecosystem Will Be Severely Impacted

902-928 MHz is a spectrum resource that is unique to the Americas (ITU Region 2), and especially to the US and Canada. 902-928 MHz is uniquely useful because its characteristics are somewhat like the UHF bands:

- Good penetration of trees

- Radios for 902-928 MHz are easier to build compared to microwave frequencies

But also similar to the microwave bands above 1 GHz:

- Antennas are small and manageable
- Antennas can be made directional, but still compact, for longer range using minimal power

Because of those aspects of 902-928 MHz, it has become the "go to" band for experimentation, innovation, and deployed services and systems. Varying uses of 902-928 MHz range from cordless telephones, to Amazon's Sidewalk Network for its smart home devices, to Amateur Radio using 902-928 MHz for Earth-Moon-Earth communications experimentation.

Another example of the utility of 902-928 MHz comes from my earlier career of writing about Wireless Internet Service Providers (WISPs). 902-928 MHz was the first band where Internet Access via wireless systems was possible. I wrote about the use of an innovative small company, WiLAN offering its "Hopper" products to some of the earliest WISPs which were then able to provide Internet service in rural areas that barely had landline telephones. Metricom, using 902-928 MHz for its Ricochet service, proved out the utility of microcells on utility poles, far predating the use of microcells by the cellular industry.

While 902-928 MHz use by WISPs have declined because other bands offered higher speeds, 902-928 MHz is still in use by many WISPs in places where its unique characteristics are useful, such as areas with extensive tree cover.

Those are just a few examples from my personal experience, amongst hundreds, perhaps thousands of use cases, technologies, and operating systems and services where the unique characteristics of 902-928 MHz and the Commission's decision to allow Licensed by Rule operations in that band have made it the preferred spectrum choice. In 902-928 MHz, the Commission has created a portion of spectrum where innovative radio technology techniques and systems can be developed, tested, and deployed rapidly and at minimal cost (no leasing or licensing of spectrum required).

From my perspective, the most impressive aspect about 902-928 MHz is that all these myriad use cases have all figured out how to "get along". 902-928 MHz is a spectrum "melting pot" or "mixed, eclectic neighborhood" where every use and user of 902-928 MHz has figured out how to fit in and get along with all the other uses and users.

And that innovation in 902-928 MHz continues to the present day and the projected future.

One of the biggest changes in 902-928 MHz in recent years is the creation of LoRa (https://www.semtech.com/lora) which is an implementation of Chirp Spread Spectrum modulation. LoRa has proven to be amazingly effective, reliable, and inexpensive. While LoRa was intended as an Internet of Things technology, it has been widely adopted by experimenters who have used LoRa units to create Meshtastic (https://meshtastic.org/), an innovative text messaging system using mesh network technology, which has no dependence on cellular, Internet, or satellite infrastructure.

Meshtastic was not created by a company, or a government program. It was created by a user community as an open source project. Meshtastic has been very widely adopted by techies, and is simple enough to build and operate user equipment and network units (relays) that non-techies can also use Meshtastic effectively. Meshtastic has kindled the curiosity and imagination of those who have been curious about radio technology (but not quite ready to become an Amateur Radio Operator). Such experimentation and self-education should be encouraged (see Spectrum Workforce later in this Comment). We don't yet know the kind of innovation that Meshtastic (and follow-on systems) can create, so we need to allow it to continue.

Several years ago, IEEE ratified a new wireless standard - 802.11ah (https://en.wikipedia.org/wiki/IEEE_802.11ah) for "extended range" networking below 1 GHz, such as 902-928 MHz in the US. In conjunction with 802.11ah, the Wi-Fi Alliance created Wi-Fi HaLow (https://www.wi-fi.org/discover-wi-fi/wi-fi-certified-halow). This degree of standardization, coupled with the unique characteristics of 902-928 MHz, incentivized radio chip manufacturers to create inexpensive devices based on these standards. Such devices have only begun to enter the US market in the past year. 802.11ah / HaLow devices show even more promise for innovation, public utility, and economic activity than LoRa because they operate at "broadband" speeds, whereas LoRa devices operate at "narrowband" speeds (by design, given its intended use as telemetry and control for "Internet of Things" applications).

Just one example of innovation and new economic activity is Teledatics (https://teledatics.io/), a new US-based manufacturer of 802.11ah / HaLow devices. Companies such as Teledatics were founded and have a market only because of the unique characteristics of 902-928 MHz as they are now. They can compete, cooperate, and coexist with other users of 902-928 MHz… but could not in the "NextNav" version of 902-928 MHz.

902-928 MHz Fills the Role of a De Facto Citizen's Data Radio Service

Over the decades, the Commission has created a number of "citizen" radio services to suit a range of intended uses:

- Citizens Band (CB)
- Family Radio Service (FRS)
- General Mobile Radio Service (GMRS)
- Multi Use Radio Service (MURS)
- The majority of the Marine VHF channels can be used for casual conversation

None of these services require technical examinations, and only GMRS requires a pro forma license from the Commission.

Thus the Commission has clearly recognized the need and utility for radio services that facilitate decentralized (no infrastructure) communications by self-selected groups to talk to one another. But other than a few of the MURS channels, there is no "citizen" radio service where data (other than very short bursts) is specifically permitted.

In this Internet / mobile phone / satellite communications era, where being continuously connected is now expected (and some consider, required), a perceived need for a "Citizen Data Radio Service" has emerged. 902-928 MHz has de facto filled that role through the use of consumer friendly data communications systems such as Meshtastic and 802.11ah / HaLow.

The emergence of Meshtastic has created amazing new independent radio-based text messaging networks in special interest groups (communities of thought) such as:

- Young women interested in tech, using a "techie" way to communicate amongst themselves.
- Casual gatherings of those living full time in recreational vehicles such as the Rubber Tramp Rendezvous in Quartzsite, Arizona.
- Students involved in STEM and Maker activities in small towns
- Children in dense inner city neighborhoods whose parents can only afford prepaid cellular Internet… but Meshtastic equipment is cheap and free and unlimited to use.
- Families and students living on native reservations where connectivity is expensive and unreliable.
- "Flotillas" of boaters anchoring down in a cove (boating equivalent of the RV example).

Meshtastic networks have become so commonplace and empowering to various communities that Iffy Books, a bookstore in Philadelphia, offers classes on how to use Meshtastic and build Meshtastic networks (https://iffybooks.net/event/meshtastic-101-class-aug-23/).

I posit that there has been amazing amounts of innovation and economic activity resulting from the creation, use, and network deployment of Meshtastic by thousands of individuals. Hundreds, perhaps thousands of new decentralized "no infrastructure" networks have been created for text messaging by leveraging low cost, low power devices, open source software, mesh networking techniques, all operating in 902-928 MHz. Contrast this with the very limited impact of the very expensive, proprietary, high power, licensed, centralized, corporate NextNav technology and systems, that NextNet claims can only be operated reasonably by reconfiguring 902-928 MHz per NextNet's requirements.

Thus if NextNav's suggested reconfiguration of the band is implemented, this de facto "Citizens Data Radio Service" role of 902-928 MHz would be severely reduced or curtailed as LoRa and 802.11ah / HaLow were designed to operate in 902-928 MHz as it is currently configured. Thus, the emerging use of LoRa / Meshtastic and 802.11ah / HaLow for providing ad-hoc communications, including emergency communications, by individuals and small groups, should be a consideration by the Commission.

The Subtle Role of 902-928 MHz in Addressing the "Spectrum Workforce" Shortage

As an agency of the US government, the FCC is well aware of the Spectrum Workforce shortage as documented in "Pillar Four" of the Biden Harris Administration's National Spectrum Strategy (https://www.ntia.gov/issues/national-spectrum-strategy). The Biden Harris

Administration considers expanding the workforce of those *deeply* knowledgeable about radio technology as crucial to US security and international competitiveness in technology. Such an expanded "Spectrum Workforce" is needed for the US to be able to "take full control" of the radio technologies used by citizens, industry, government, and military. Currently, as with semiconductor manufacturing, the US is vulnerable that much of the radio technology it uses is created and manufactured by other countries that may render the US vulnerable if such technology is withheld or tampered with.

While 902-928 MHz may not seem relevant to the Spectrum Workforce shortage, I posit that it is indeed relevant because Science, Technology, Engineering, and Math (STEM) programs and hardware (used by "Makers") make use of radio technology, and increasingly that hardware uses LoRa and other radio technologies that operate on 902-928 MHz. STEM and Maker activities that involve radio communications, such as robots, airborne drones, and instructive projects such as monitoring a favorite plant's soil moisture via radio, usually use 902-928 MHz. That band offers range, higher reliability than the very heavily used 2.4 GHz / 5.x GHz bands, and choice of a number of radio technologies ranging from frequency hopping, to narrowband, even to (wideband) digital video. As an example of how widely used 902-928 MHz is used in STEM and Maker activities, a quick search of Adafruit (https://www.adafruit.com), a popular supplier of STEM and Maker electronic modules, shows 21 matches for "915 MHz", and 54 pages in a search for "LoRa".

I posit that being able to teach the use of radio technology in STEM / Maker activities is as critical as teaching basic electronics, programming, and physical construction (such as 3D printing). If a student is taught to "assume that a radio link will always work", when it inevitably does not work due to interference, electronic failure, or even a cyberattack (taking control of the radio link), the result is situations such as vehicles being easily stolen because poor security practices were used in designing the vehicle's "wireless key fob". Using radio technology such as 902-928 MHz in STEM and Maker activities teaches students to understand radio technology at low level, and puts them on a path to potentially be part of the future Spectrum Workforce.

Is NextNav's Proprietary Technology Worth "Sacrificing" the Flourishing Spectrum Ecosystem of 902-928 MHz?

In this section, I do not intend to "challenge" NextNav's technology assertions. But I do wish to offer some "bigger picture" perspective to some of NextNav's claims that only their proprietary technology can be a backup in the US for navigation and timing services provided by GNSS systems.

PNT Services

In the past two decades since NextNav obtained its licenses and began operations in 902-928 MHz, other approaches to offer Positioning, Navigation, and Timing (PNT) services, independent of GNSS services, have emerged that do not require the use of 902-928 MHz, and especially do not require the reconfiguration of the 902-928 MHz band per NextNav's request.

Broadcast Positioning Service - BPS

One of the most promising such systems that can back up GNSS in urban areas and could quickly become ubiquitous is the Broadcast Positioning System (BPS) (https://www.gps.gov/governance/advisory/meetings/2022-11/matheny-mondal.pdf) that is a subsystem of over the air television transmissions that have been upgraded to the ATSC 3.0 (Next Gen TV) standard.

eLORAN

For wide area backup of GNSS, such as use on marine vessels, is Enhanced Long Range Aid to Navigation - eLORAN (https://gps.stanford.edu/research/early-gpspnt-research/enhanced-long-range-navigation-eloran). As with all technologies, especially radio technologies, capabilities have vastly increased, and costs have exponentially decreased, and LORAN technology and now eLORAN technology is no exception. If the US is serious about the requirement of a backup system for wide area positioning and navigation, LORAN and eLORAN technology is proven.

Inertial Navigation Systems - INS

For mobile platforms that require precise navigation, but must be able to navigate without relying on GNSS, technology has advanced to create cost-effective Inertial Navigation Systems (INS) (https://www.advancednavigation.com/tech-articles/the-critical-role-of-inertial-navigation-in-armored-combat-vehicles-ensuring-precision-in-gnss-denied-environments).

Rubidium Atomic Timebases

For providing precision timekeeping, as with all technology, the state of the art and functionality of standalone precision timebases has become much more affordable than they were two decades ago. A rubidium atomic timebase system such as required for radio system network coordination (https://www.thinksrs.com/products/sr625.html) is now available for $7,000. Such a unit was many times that cost two decades ago, which drove the use of GPS receivers to be used as inexpensive precision timebase systems.

“5G” Spectrum

The Commission has made huge amounts of “5G” spectrum available in the past two decades, calling into question that NextNav’s assertion that its requested reconfiguration of 902-928 MHz provides needed “5G” spectrum.

CBRS - 150 MHz of “5G” Spectrum

In the last decade, the Commission created a sharing system that made 150 MHz of “5G” spectrum - 3.55 - 3.70 GHz, the Citizens Broadband Radio Service (CBRS) available. Not only was CBRS an innovative way to allocate “new” spectrum, this spectrum can be used not just by cellular carriers but also enterprises, and very small entities such as individual commercial buildings, college campuses, and small businesses.

Wi-Fi 6E (6 GHz) - More Than 1 GHz of "5G" Spectrum

In the most notable allocation of spectrum of late, the Commission allocated more than 1 GHz of spectrum at 6 GHz for license by rule use, most widely known as Wi-Fi 6E. With the this much spectrum being made available, cellular carriers are able to "offload" some of their customer's activity onto 6 GHz, such as picocells and microcells, freeing up localized usage of their "wide area" spectrum.

Galileo - Robust GNSS Services

NextNav makes the claim that GNSS signals can be easily disrupted or "spoofed". But newer GNSS technology has advanced to provide GNSS capabilities that are far more resistant to jamming than GPS. Europe's new Galileo GNSS system cryptographically "signs" its transmissions, thus simple spoofing can be detected and ignored (https://www.septentrio.com/en/learn-more/insights/osnma-latest-gnss-anti-spoofing-security).

In Conclusion

In Docket 24-240, NextNav has proposed a radical reconfiguration of the 902-928 MHz band. If adopted, NextNav's reconfiguration will be highly disruptive, and in many cases destructive (no practical or cost effective way to adapt to the reconfiguration) to hundreds of systems and likely tens, or possibly hundreds of millions of individual units that use 902-928 MHz daily.

It's not hyperbole to project that entire companies that manufacture units that operate in 902-928 MHz or operate systems in 902-928 MHz will simply go out of business from the immense costs of having to reconfigure their units or systems.

Just to cite one example of 902-928 MHz usage, many (most?) utility systems use Automatic Meter Reading (AMR) transmitters operating in 902-928 MHz. My former home in suburban Seattle had three such transmitters - one each for the water meter, the natural gas meter, and one for the electricity meter. And every thousand feet or so on a utility pole was an AMR "repeater" unit to receive the transmissions from the meters. All of those AMR transmitters, and entire networks of "repeater" units would need to be manually replaced - hugely disruptive, and hugely expensive, with the cost ultimately being borne by utility customers… unless NextNav proposes to pay for those equipment replacement costs.

Amateur Radio's role in providing emergency communications services with repeaters operating in 902-928 MHz would be effectively shut down as there's no affordable method available to change Amateur Radio operations to accommodate NextNav's proposed reconfiguration of 902-928 MHz… unless NextNav proposes to pay to create a new class of Amateur Radio repeaters and user radios to conform to its proposed reconfiguration of 902-928 MHz.

The use of 902-928 MHz as a de facto "Citizens Data Radio Service" would be severely impacted. All new LoRa and 802.11ah / HaLow units would have to developed to conform to NextNav's proposed reconfiguration of 902-928 MHz. While the cost of the individual units is low, and it's feasible to "simply buy a new "conforms with NextNav" unit, the development costs for new LoRa and new 802.11ah / HaLow systems would be huge, and many small

companies such as Teledatics would probably be forced out of business by such development costs… unless NextNav proposes to reimburse Teledatics and many other companies for the costs to redesign their systems to NextNav's configuration of 902-928 MHz.

Lastly, in the "Is NextNav's Proprietary Technology Worth "Sacrificing" the Flourishing Spectrum Ecosystem of 902-928 MHz?" section, while NextNav legitimately posits that there are a number of issues resulting from over dependence on the US GPS system, such as location, navigation, and precision time services…

I briefly mentioned a number of other solutions for those issue that seem equally as viable as NextNav's proprietary technology which would requires the huge disruption of current configuration, users, and usage of 902-928 MHz.

Managing the Radio Spectrum for the Broadest Possible Public Interest

In the most broad perspective of the Commission's "mission", it is to manage the portion of the electromagnetic spectrum that is "usable for radio communications" to the highest and best use for the broadest possible public interest. The Titanic sinking, and rescue, in 1912 was the first major critical use of radio communications technology. The aftermath of the Titanic sinking required new management of radio spectrum to make ship communications reliable. That management required making some hard decisions about "highest and best use" of competing user communities (such as segmenting radio broadcasting and ship communications into separate portions of the radio spectrum) and choosing between competing technologies to effectively use limited radio spectrum.

In Docket 24-240, the Commission is again tasked with making decisions about "highest and best use" of competing user communities and competing technologies to effectively use the limited radio spectrum of 902-928 MHz.

In the totality of the unique nature of 902-928 MHz, the diverse users and systems that have evolved, and thrived, and profited in 902-928 MHz as it is currently configured, and the availability of systems that can provide effective backup of PNT services provided by GPS in the US…

NextNav's Proposed Reconfiguration of 902-928 MHz is Not In the Broadest Possible Public Interest

I respectfully suggest that NextNet's proposed reconfiguration of 902-928 MHz is simply not in the broadest possible public interest. Thus I recommend that to the Commission that in evaluating Docket 24-240 NextNav's proposed reconfiguration of 902-928 MHz should be denied.

Signed,

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Join the *Fun* on Amateur Radio

If you're not yet licensed as an Amateur Radio Operator, and would like to join the fun by *literally having a license to experiment with radio technology*, check out **Join the Fun on Amateur Radio** for some pointers.

Zero Retries Frequently Asked Questions (FAQs) — In development 2023-02.

Closing the Channel

In its mission to highlight technological innovation in Amateur Radio, promote Amateur Radio to techies as a literal license to experiment with radio technology, and make Amateur Radio more relevant to society in the 2020s and beyond, Zero Retries is published via email and web, and is available to everyone at no cost. Zero Retries is proud *not to participate* in the Amateur Radio Publishing Industrial Complex, which hides Amateur Radio content behind paywalls.

My ongoing ***Thanks*** to:

- Tina Stroh KD7WSF for, well, *everything!*
- ***Annual Founding Members*** **who generously support Zero Retries financially:**
  Founding Member 0000 - Steven Davidson K3FZT (Renewed 2024)

  Founding Member 0001 - Prefers to Remain Anonymous 01 (Renewed 2024)
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- Numerous Annual and Monthly subscribers who also generously support Zero Retries financially!

Want to Support Zero Retries?

- The *most* effective way to support Zero Retries is to simply mention Zero Retries to your co-conspirators that are also interested in knowing more about technological innovation that is occurring in Amateur Radio and encourage them to become a fellow subscriber.
- One particularly effective method of promoting Zero Retries is to add a mention of Zero Retries to your QRZ page (or other web presence) and include a link:

https://www.zeroretries.org

- If you'd like to financially support Zero Retries, becoming a paid subscriber is *greatly* appreciated and helps offset expenses incurred in publishing Zero Retries. Paid subscriptions for Zero Retries are *entirely optional*, as explained in this special issue of ZR:
  Zero Retries Administrivia - Activating Payment Options.

These blogs and newsletters regularly feature Zero Retries Interesting content:

- Dan Romanchik KB6NU mentions "Zero Retries Interesting" topics so regularly on his blog (that I otherwise wouldn't know about) that I've bestowed on him the honorific of Pseudostaffer.

- Jeff Davis KE9V also mentions "Zero Retries Interesting" topics so regularly on his blog (that I otherwise wouldn't know about) that I've bestowed on him the honorific of Pseudostaffer.

- Amateur Radio Weekly by Cale Mooth K4HCK is a weekly anthology of links to interesting Amateur Radio stories that often feature "Zero Retires Interesting" topics.

- Experimental Radio News by Bennet Z. Kobb AK4AV discusses (in detail) Experimental (Part 5) licenses issued by the US FCC. It's a *must-read-now* for me!

- RTL-SDR Blog - *Excellent* coverage of Software Defined Radio units.

- TAPR Packet Status Register has been published continuously since 1982.

- Hot Iron - The Journal of the Constructor's Club is a delightful quarterly newsletter.

- Other Substack Amateur Radio newsletters recommended by Zero Retries.

These YouTube channels regularly feature Zero Retries Interesting content:

- HB9BLA Wireless by Andreas Spiess HB9BLA

- KM6LYW Radio by Craig Lamparter KM6LYW (home of the DigiPi project)

- Modern Ham by Billy Penley KN4MKB

- Tech Minds by Matthew Miller M0DQW

These podcasts regularly feature Zero Retries Interesting content:

- Ham Radio Workbench by George Zafiropoulos KJ6VU (and friends)

- Foundations of Amateur Radio by Onno Benschop VK6FLAB

Zero Retries is currently using the Substack email publishing platform to publish Zero Retries. It's particularly suitable for small newsletters as you can get started for no cost.

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Zero Retries (N8GNJ) is also on Bluesky — @n8gnj — just click:

Zero Retries / N8GNJ on Bluesky

Email issues of Zero Retries are "instrumented" by Substack to gather basic statistics about opens, clicking links, etc.

More bits from Steve Stroh N8GNJ:

- **Store and Forward Podcast** - a podcast about the past and future of amateur radio, by Kay Savetz K6KJN (curator of the Digital Library of Amateur Radio and Communications) and Steve Stroh N8GNJ (Editor of the Zero Retries newsletter.)
- **SuperPacket blog** — *Discussing new generations of Amateur Radio Data Communications - beyond Packet Radio (a precursor to Zero Retries)*
- **N8GNJ blog** — *Amateur Radio Station N8GNJ and the mad science experiments at N8GNJ Labs in Bellingham, Washington, USA*

Thanks for reading!
Steve Stroh N8GNJ / WRPS598 (He / Him / His)
These bits were handcrafted (by a mere human, not an Artificial Intelligence bot) in beautiful Bellingham (The City of Subdued Excitement), Washington, USA, and linked to the Internet via **Starlink *Satellite* Internet Access**.

2024-09-04

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Footnotes for this Issue

1

For new readers, I specifically "exclude" ARRL's magazines from this plaint as the vast majority of their content is restricted behind a paywall, and less than 20% of US Amateur Radio Operators (and falling) can access such content - in perpetuity (given ARRL's current policies). I won't write for ARRL's magazines for this reason, and encourage others not to do so.

2

I take some comfort in reading The Random Wire that I'm not the only Amateur Radio newsletter editor (on Substack) that regularly blows past Substack's "recommended length for email".

3

Literally, when I began using operating systems that supported more than 8 uppercase characters in a filename, that was one of the happier moments in my life.

4

CTIA is the industry association for the "cellular" industry. Their inputs and requirements are a priority with the FCC. I haven't seen any mention that Docket 24-240 is of interest to them.

5

NAB is the industry association from the broadcasting industry. Their inputs and requirements are also a priority with the FCC. There is some relevance to television broadcasting relating to Docket 24-240 that ATSC 3.0 technology can provide alternative PNT services to NextNav's PNT services.